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Antidromy of Plants.*

By George Macloskie.

During the summer of 1893 I made observations on Indian corn, which were published in abstract in the Princeton College Bulletin of November, 1893. It was then shown that, if we judge from the modes of overlapping of the leaf margins of Maize and of other Gramineae, there must be two kinds of plants of every species of the order; the one kind or "caste" has its lowest foliage leaf (the leaf next above the pileolus in the embryo) with the right margin of its sheath overlapping the left margin, "dextrally infolded" as I term it; and the other caste has the left margin overlapping the right, "sinistrally infolded." The leaves at subsequent nodes are alternately sinistral and dextral. In order to ascertain the origin of this duplicity I read Van Tieghem's researches on the Cotyledons of the Gramineae (Ann. des Sci. Naturelles, 1872), which stated that the leaves of the plumule within the seed are alternately enfolded on each other, but failed to indicate the direction of the enfolding of the first leaf.† The dissection of one or two seeds revealed a dextral initial folding; and soon other grains were found with sinistral folding. Thus it became manifest that as there are two castes of maize-plant, so

* Read before Section G., A. A. A. S., Springfield meeting, September, 1895.

† He states that the direction of the evolution of the leaves is determinate, but there is variation as to the first green leaf, and he had not been able to discover its cause.

there are two castes of grains, the one being the "antidrom" of the other, the leaf-folding starting diversely, and the leaves of successive nodes, running contrariwise in the plumule of one grain as compared with that of another grain.

The next problem was to orientate the grains of each caste in the ear of Maize. The ear consists of columns each containing a pair of rows of grains; we may designate the row opposite our right hand dextral and the other row (opposite our left) as sinistral. It was soon made out that in the particular ear examined, the grains of the dextral row were all with dextral embryos, and those of the sinistral row had sinistral embryos. Whether this law would apply to all the ears on one plant, or whether the order would be inverted between the ears arising from successive nodes, or between the ears of different plants, is yet to be determined. On examining the very young ear of maize I found the grains of the paired rows of each column orientated close to each other, almost face to face, the young styles running up together, and a gap between the adjoining two-rowed columns.

From this discovery the inference was obvious that the seeds of corn differ from each other antidromically, according to the side of the placenta or axis from which they arise; that their embryos vary in consequenee, and determine the caste of the future plant. Whilst it was easy to see that the same rule will include all the Gramineae, I hazarded the suggestion that it may be found in some measure to dominate other orders of plants. The discovery as to the corn disposes of Sachs's crowning argument against phyllotaxy, which he supposed could have no significancy as to Gramineae, on account of their distichous leaves.

Early in August, 1895, I was struck by the graceful inflorescence of Ladies' Tresses (*Spiranthes praecox* Watson, *S. graminea* var. *Walteri* Gray). Its spiral rows of pure white flowers are antidromic as between different individual plants; about half the specimens have dextral spirals (viz., turning in the direction of the thread of a common screw), and the same number have sinistral spirals. Another interesting point was that the phyllotaxy, or arrangement of the distichous leaves in a primitive spiral, of each of the plants of *Sptranthes* follows the order of the inflorescence, dextrorse phyllotaxy invariably accompanying the dextrorse an-

thotaxy, and conversely.* The numerous seeds of these plants are too small to be easily compared together; but the phyllotaxy or even the inflorescence serves as our best guide when other indications fail. A similar remark will apply to *Oenothera biennis*, whose inflorescence curves to the right or left in the same direction as the leaves; though not always so easily determined as in Ladies' Tresses. In some cases the seeds form a ready guide. For example, the Lima-bean is found on examination to have its cotyledons right and left, and two foliage leaves respectively dorsal and ventral (towards the dorsal and ventral sutures of the pod). Now I found that the right margin of the dorsal leaf of the plumule of one seed overlaps the right margin of the ventral leaf, but the left margin of the dorsal leaf is overlapped by the left margin of the ventral leaf; and in another seed these relations are reversed. I also found that the seeds growing on one valve of the pod, being Nos. 1, 3, 5, were all similar; whilst the seeds on the other valve, being Nos. 2, 4, were reversed. Thus the seeds on one margin of a carpel are found to be antidromically related to those on the opposite margin. (I have not examined whether successive pods from the same plant reverse these characters or not.) The pea showed its antidromy best when germinating, the emerging plumules of different seeds appearing under careful orientation to come up with opposing twists. The large plumule of the Almond seed can be seen by dissection to have two modes of torsion in different seeds. The akenes of *Caffea* exhibit antidromy, an interesting point in this plant as the opposite leaves render the determination otherwise difficult. The deeply enfolded endosperm of the coffee-bean is seen on a cross-section of different seeds to be in opposite directions; a mark which is a sure indication of similar diversity in the minute embryo. Even from the outside the two kinds of akenes are easily distinguishable, the figure of one reversing that of the other like one's right and left hand, thus proving that the two mericarps are relatively antidromic; and confirming the evidence already derived from the corn and Lima-bean, as to the origin of this character.

* Dextral phyllotaxy has the primary spiral traced by the insertion of the leaves directed like the thread of a common screw. With leaves overlapping at the margins, dextral overlapping may produce sinistral phyllotaxy.

The case of *Banksia* of Proteaceae further illustrates the subject. Judging from the figure in Engler and Prantl's Pflanzenfamilien, (3 : part 1, 152) it has a pair of flowers, situated back to back, with bractlets, stamens, ovary and seeds, all antidromic; in this case the diversity of the seeds seems to be anticipated by the structure of the flower. The flowers on the same branch of *Althaea* have their petals twisted in contrary directions.

In connection with the explanation of antidromy as depending on the origin of seeds along the margins of a bilateral organ, it would be interesting to examine the few cases in which seeds are represented as terminal on the floral axis, a view which may be confirmed or refuted by this law. It is likewise interesting to note that in specimens of *Bryophyllum calycinum* (kindly furnished me by Prof. S. T. Maynard, of Amherst Agricultural College), I was able in this opposite-leaved flower to make out the marginal buds on the leaves to be antidromous. The Calla lily (*Richardia*) has both the alabaster spathe and the arrangement of the akenes on the spadix antidromic as between plants which grow from the same rootstock. The Iris also when growing by bifurcation of the rootstalk gives antidromic plants; how they are when propagated by lateral branching I cannot say. Rushes growing together in clumps are antidromic as between the individuals united at the base of the rootstalk (I do not find it so in *Carex* or grasses growing in tufts; all of the same tuft seem to me to be homodromic, but this subject requires more careful examination than I have made).

Phyllotaxy is a particular outcome of antidromy, and in very many cases is the readiest evidence of the antidromic organization of the plant. But whilst antidromy is a primitive character, influencing the general morphology of the plant, yet each part of the evidence, and most frequently the order of the leaves, the inflorescence and the perianth, may be modified by secondary changes, which send us back to the mother-seed and its germination as the only remaining proof of the primitive character. Twining of stems, contortion of perianth, accumulations of flowers in complex ramifications, leaves becoming opposite, or being spread out to the sunlight, and even difficulties of orientation of seeds disguise the truth and explain why it has so long remained a

secret. The distortions of phyllotaxy misled the early students on the subject, so as to nearly banish the term and the theme from botanical science. Old books spoke vaguely of some plants being *homodromous* and others *heterodromous*, without attempting to find any law to explain these apparent irregularities. We now see its significancy and find its anomalies all reduced to order, and we must welcome it back to its rightful place. So far as I have been able to find, all plants are homodromic within the individual, and heterodromic as between different individuals of the same species. Apparent exceptions to these rules are no more than apparent, and if anybody will set himself to look up the evidence, it will soon be so overwhelming, and nothing against it, as to render his work monotonous. Go into the nearest orchard and you will find two kinds of every species of fruit tree, two kinds of every shrub, two kinds of common flowers, having the primary spirals of the leaf-insertions dextral in one set and sinistral in the other set. In case of plants with opposite leaves this evidence will fail you, for you can make out two crossing primary spirals in the same branch; in other cases you are baffled by the leaves assuming new positions for the sake of the light, though sometimes even in these plants you may find the primitive traits in branches not exposed to the sunlight.

With a few weeks' observation I have found double phyllotaxy, as a mark of antidromy in the following plants representing the more important orders of Phaenogams: *Delphinium* (Ranunculaceae), *Liriodendron* (Magnoliaceae), *Bocconia* (Papaveraceae), mustard (Cruciferae), *Abutilon* and *Hibiscus* (Malvaceae), *Pelargonium* and *Impatiens* (Geraniaceae), bean and pea (Leguminosae), apple, pear, peach (Rosaceae), *Oenothera* (Onagraceae), carrot (Umbelliferae), sunflower and other Compositae, *Lobelia* (Lobelieae), *Myosotis* (Borraginaceae), *Verbascum* (Scrophulariaceae), tobacco (Solanaceae), *Polygonum* (Polygonaceae), *Ricinus* (Euphorbiaceae), *Salix* (Saliaceae), *Quercus* (Cupuliferae), and among monocotyledons, lily (Liliaceae), *Musa*, Ladies' Tresses (Orchidaceae), species of Aroideae, Iridaceae, Juncaceae, Cyperaceae, Gramineae. To the above we have to add from the perianth and arrangement of stamens Nymphaeaceae; and by the courtesy of Mr. Everett H. Barney, of Springfield, Mass., I was furnished from the Forest Park Ponds

with seeds of *Nelumbium* which on being opened, showed the embryos rich in chlorophyll, with their leaves in one seed folded round in the inverse order of those in another seed; besides this the insertion of the stamens in the flower of different individuals of *Nelumbium* form antidromic spirals. A special case among the Liliaceae is *Convallaria majalis*, whose two leaves are at the usual angle among the Monocotyledones of 120°, and as one of the leaves forms a sheath around the other, it is instructive to observe how in a bed of Lily-of-the-Valley, all the plants being regarded under the same orientation, the inner leaf in half the plants bends over 120° to the right, and in the other half to the left. Arthur K. Harrison of Lebanon Springs, N. Y., informs me that before he heard of my work he had taken note of the double phyllotaxy of *Veratrum viride*.

With a little care we can make out the general law as applying to the Gymnosperms; both the phyllotaxy and the spirals of the cones of Coniferae show it; and it may be expected to manifest its presence in the relative position of the cotyledon, during germination; also in the embryo and its suspensor in *Cycas*. (See figures in Engler & Prantl, 2: 1. 17.)

I have not yet tried the opposite-leaved orders, further than the case of *Caffea*, and that of *Bryophyllum*, as insufficiently tested by the marginal buds on the leaves; if this last observation be verified, it may reinforce the old doctrine that ovules are the homologues of such marginal buds. *Acer platanoides* shows it by the antidromic folding of the cotyledons of the seeds of adjoining carpels; also *Aesculus* by the contrary curvature of its radicles and by its plumules. Nor have I tried the twiners and climbers, saving that I have partially succeeded with Morning-glory (Convolvulaceae). Its embryo resembles that of some Cruciferae in having the radicle folded "incumbently" upon the cotyledons; and again (unlike the Cruciferae) its orientation is changed so that the radicle lies next the floral axis and the cotyledons lie towards the periphery. Now if we reduce the orientation back to that of Cruciferae, we shall find a very close correspondence of the embryonic structures in the two orders, and the same antidromic difference will be found in Convolvulaceae that is readily shown by the phyllotaxy of Cruciferae.

The embryo of *Lepidium Virginicum* has its cotyledons twisted so as to be erroneously described in the books as accumbent; something similar occurs in *Sisymbrium officinale*. In these cases the adjoining seeds have the embryos twisted in contrary directions, so that the apparent anomalies are explained as cases of pronounced antidromy. Whilst the pericarp of akenes follows the torsion of the enclosed seed, capsular pericarps seem to follow the phyllotaxy of the mother plant; thus the pods of mesquit (*Prosopis*) are similarly twisted in the same plant, as are those of *Medicago*, those of balsam (*Impatiens fulva* and *I. balsamina*) spring open with a right or left twist in harmony with the dextral or sinistral phyllotaxy of the bearing plant.

Amongst the peculiar cases that occurred was that of *Salix Babylonica*, of which only the female plants are known; and consequently there is no reproduction by seed, and we expected to find no antidromy. Specimens growing about Princeton appear to be sinistral in their phyllotaxy, and as tradition derives them from the tree growing by Napoleon's grave at St. Helena the inference arises that the St. Helena willow also was sinistral. This inference is confirmed by a young tree in Forest Park, at Springfield, which Mr. Barney knows to have come from St. Helena. But other specimens of the same species with dextral phyllotaxy are common. Thus we learn that whilst all representatives of the male line of this species have probably perished, there are at least two independent branches of the female line perpetuated by cuttings.

Another interesting case is that of *Canna*. The leaves of all the specimens which I have found at Northampton, Mass., and at Princeton, are when young spirally folded, right flap uppermost, and when expanded have a slightly dextral phyllotaxy. I am told that this is usually propagated from bulbs; but that it is sometimes grown from seeds; if this last statement be true we should expect individuals of both castes; but I have been unable to find any except the one caste (even a second variety bearing reddish leaves is by coincidence of the same cast as the common one). Doubtless the other caste occurs through the country.

The scape or flower-stalk of *Canna* may cast light on the structure of Gramineae. Whilst all the foliage leaves of the *Canna*

(so far as I have seen it) are dextral, the flower-stalk is provided with a succession of sheathing bracts, the edges folding over each other in reversed order at every succeeding node. This is exactly as in Maize, being a special kind of phyllotaxy, which depends not on a primary spiral, but on a reciprocating overlapping of the margin of sheathing organs; also a double leaf between each branch and the mother-axis is present as described by Van Tieghem in Maize. Thus it appears that the whole corn-plant, culm, leaves and flowers is the counterpart of the flower-stalk of canna and of its bracts and flowers, but having no representative of its foliage-leaves. According to this view one part of the reduction of the Gramineae is the non-development of proper foliage leaves, and by way of compensation the excessive development of the bracts with a green lamina for assimilation. It is of special advantage to gregarious plants to have their assimilating organs lifted up to the air and sunshine. (No notice is taken of the peculiar alternancy of leaves of gramineae by Pax, Vines or the other recent writers on Morphology).

Among the results of this account may be mentioned the extension of unity of primitive structure thus shown to exist among all the Phaenogams; a unity that may yet be found to include some of the Cryptogams; also the relative simplicity of the Monocotyledones, which show few secondary distortions, though they are often reduced. A new problem of heredity is started, running differently through two sides of the carpel; yet each seed transmits both castes, one to appear forthwith in its immediate offspring, and the other to appear ultimately in a moiety of its successors. The objection that the discontinuity between carpel and ovule negatives the possibility of such transmission of characters is of no weight; the discontinuity is only apparent, for characters of secondary acquirement are carried across the gap, and *a fortiori* we may expect such a primitive law of organization as antidromy to be inherited. This law is also useful to suggest discovery. It suggested to me at the outset diversities between the stalks and inflorescence of Iris that had escaped Arnold Dodel in his study and illustration of *Iris Sibirica*, which was the work of some years; it has also opened problems about the significancy of opposite leaves, the real direction of leaf-traces in stem-struc-

ture (hitherto assumed to be entirely symmetrical) and other subjects bearing on vegetable anatomy, and the difficulties which brought discredit on phyllotaxy all vanish. Perhaps it may furnish a solution of the problem why wooden poles split in antidromic spirals, for which phenomenon some people have suggested the stress of wind on the living tree.

My work has been necessarily hurried; and I shall be glad if others will verify or amend it, and help to fill the many lacunae which I am compelled to leave unsupplied.

PRINCETON COLLEGE, Sept. 7, 1895.

Description of a new problematical Plant from the Lower Cretaceous of Arkansas.

BY F. H. KNOWLTON.

PALEOHILLIA ARKANSANA gen. et. sp. nov.

Stems hollow, .5–.75 cm. in diameter, several centimetres long, broken; wall two or three layers of cells thick; cells of epidermis of two kinds: 3–5 longitudinal rows of elongated, thin-walled cells that are two or three times longer than wide, alternating with broad bands of shorter and more irregular cells; stomata numerous, confined to the broad bands of irregular cells, arranged in three rows, two next to the rows of elongated cells with a row of distant ones between; stomata with apparently 4–6, usually 5, guardian cells.

The material upon which this description is based was collected by Prof. R. T. Hill, of the United States Geological Survey, during the season of 1888, while engaged under the auspices of the Arkansas Geological Survey in making a general investigation of the geology of southwestern Arkansas. It came from a gulch on one of the smaller branches of the Muddy Fork of Little River, about six miles northeast of Center Point, Howard county. The deposits containing these fossils were referred by Prof. Hill to the Trinity Division of the Lower Cretaceous. The beds are described as consisting of basal ferruginous sands, succeeded by firm white or yellow sand often filled with small concretions of iron pyrites, and mixed with clay. This clay is in sufficient quantity to bind the sandy material together "so that in drying it often becomes

almost as hard as burnt brick." It was in this clayey material that these plant-stems were found.

The stems are very abundant and scattered in all directions through the mass. They appear to have been much rolled about and broken up, it being difficult to find a piece three centimetres in length. They were originally hollow, but most of them are now pressed perfectly flat, although an occasional one is found that was filled with clay when probably in a fresh state and consequently retains nearly its cylindrical form. When liberated by the crumbling of the sandy clay, the stems are very dark brown, almost black, in color and perfectly opaque. By boiling them for a few moments in dilute acid, a large part of the coloring matter was discharged and the cellular structure could then be made out.

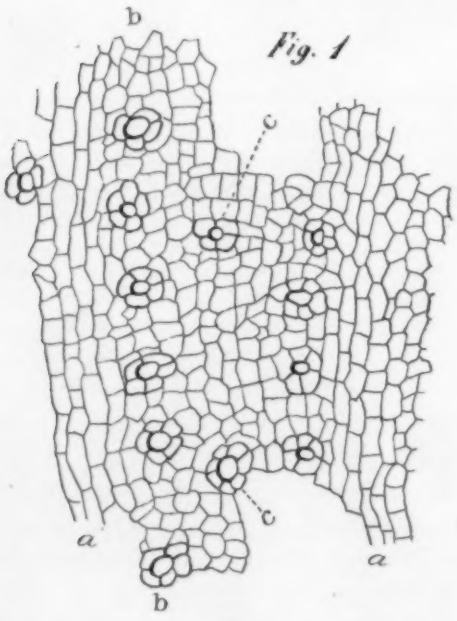


Fig. 1

Fig. 2

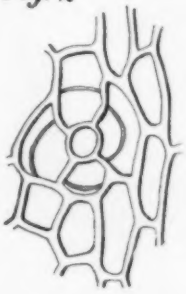


Fig. 3

Fig. 1.—Epidermis of *Paleohillia Arkansana* × 90.
a, a, bands of long, narrow cells.
b, b, bands of short irregular cells, with three longitudinal rows of stomata.
c, c, stomata with four and six guardian cells respectively.
Fig. 2.—Stoma with four guardian cells × 300.
Fig. 3.—Stoma with five guardian cells × 300.

This curious plant, as already stated, was hollow, with the walls consisting of three or four, or possibly more, layers of cells. The epidermal cells are markedly separable into two kinds: first, narrow bands of three or four rows of thin-walled cells which are two to four times longer than broad, separated by broad areas or bands ten or twelve cells wide, of short irregularly quadrangular cells. In figure 1 a, a, represents the bands of narrow cells, and b, b, the short irregular cells. Under the microscope the two kinds of cells divide the surface longitudinally in very clearly mark parallel lines.

The stomata are the most remarkable feature about this plant. As may be seen by the drawing, the guardian cells are quite irregular in shape and appear to vary in number from four to six, the most frequent number being five.* The opening is in all cases large and in some instances appears even larger than either of its guardian cells. It is difficult to see how so large an orifice could be completely closed by them.

The stomata, it will be observed, are confined to the broad bands of irregular cells, and are also arranged in longitudinal rows, those next to the bands of long cells being numerous, while in the central row they are scattered, there being only about one-third as many as in the others. The orifice between the guardian cells is approximately circular. The guardian cells are themselves arranged in a more or less regularly circular manner, their shape depending on the number present. When there are only four they are rectangular with rounded outer sides; when there are five or more they are keystone-shaped, or broadly wedge-shaped.

I am at the present time unable to suggest any satisfactory relationship, either living or fossil, for this anomalous plant. The first thought when seeing the numerous fragmentary stems throughout the clay mass, and finding that they are hollow, is that they belong to *Equisetum*. But on examining large numbers of fragments, not a single joint with the characteristic teeth could be detected, and moreover the stomata are entirely different. It is of course well known that the stomata of living *Equisetum* have two

* In figure 1 the guardian cells appear to be in the same plane as the epidermal cells. They are of course below them, but the lines of the overlying epidermal cells have not been drawn in, so that there may be less confusion in following their outline. Figures 2 and 3, much enlarged views of single stomata, make the real condition plain.

pairs of guardian cells, but they are not all in the same horizontal plane, one pair, the "subsidiary cells," of Strasburger being below the other. The guardian cells are usually ornamented by silicified ridges radiating from the orifice, not a trace of which can be found in the fossil under discussion.

Some of the Bryophytes, notably the liverworts, have stomata with more than two guardian cells, but they are loosely cellular plants quite unlike this hollow-stemmed plant.

In the absence of more specific information as to its affinities, I have decided to describe this plant under a tentative name, recognizing the fact that this provisional name may be changed at any time provided the fossil can be more definitely placed. I had at first given it the name of *Hillia*, but as there is a genus of this name in Rubiaceae, I have called it *Paleohillia*. It commemorates the collector and is not intended to imply relationship with the Rubiaceous genus.

Observations upon some Oklahoma Plants.

By Edgar W. Olive.

The botany of Oklahoma is exceedingly interesting, because this territory is a borderland region between the Gray's Manual and Western Texas Manual regions. Until about five years ago, the plants of this district were but little known to botanists, and the results of recent collections disclose a flora rich in interesting forms. Especially valuable is a "List of Plants collected by C. S. Sheldon and M. A. Carleton in the Indian Territory in 1891," published as a contribution from the National Herbarium in 1892.

The months of July and August, 1893, were spent in and about Payne county, in the very northeast of Oklahoma, about 90 miles south of the Kansas line through the Cherokee strip, and about 150 miles west of Arkansas. This is in lat. 97° W. and is but a few miles south of the parallel bounding on the north Tennessee and North Carolina, so that the collections were made just south

of the line of the extreme southwestern limit of Gray's Man. 6th Ed. About 175 species of Phanerogams and Pteridophytes were collected, about 60 of them new to Messrs. Sheldon and Carleton's list, most of these, however, the commoner plants, and 12 of which are not reported in Gray's Manual. Of these 12, 3 are not included in Dr. Coulter's Manual of the Texas Flora, nor 8 of them in his Botany of the Rocky Mountain region.

These 12 plants are *Talinum calycinum* Engelm., found abundantly on the red sandstone rocks outcroping in ravines and along the Cimarron River; *Desmanthus Jamesii* T. & G., very abundant on dry prairies; *Galactia mollis* Michx., in sand along the river banks; *Acacia filiculoides* (Cav.) Trel., abundant in the sandy woods; *Gaura villosa* Torr., showing gradations into forms; *Sesuvium Portulacastrum* L., in sand along the saline banks of the river; *Cynosciadium pinnatum* DC., but one plant collected by a roadside; *Aster patens* Ait., var. *gracilis* Hook., the variety not in Gray's Manual, very abundant in rich sandy ground near the river; *Baccharis glutinosa* Pers., the fertile plant conspicuous by its very long and white pappus along the sandy river banks; *Eriogonum longifolium* Nutt., on dry prairies; *Aphanostephus ramosissimus* DC., found in abundance in the sand of rich river bottoms; *Cooperia Drummondii* Herb., near Stillwater on rich prairies.

The flora of Oklahoma is very similar to that of southern Kansas. The climatic and geologic conditions are very similar in both regions, and this fact, combined with the fact of the proximity of the Cimarron and Arkansas rivers flowing southward through the territory from Kansas, tends to make the floras alike. Outcropping "red-beds" (whence probably the name *Oklahoma*—"home of the red earth") occur in both regions associated generally with a very sandy soil. Rich, sandy land, well timbered, occurs along the rivers and creeks, while back some distance on the uplands, prairies supplant the forests. The farther west one goes, the observer can readily notice the dwarfing of the trees as the regions of less rainfall are passed through, and many plants show gradation into dwarfed forms. Most of the plants of this whole district, moreover, present the characteristics of the plants of dry sterile regions, viz., thickened leaves and epidermis, sunken sto-

mata, absence or narrowness of leaves, or an unusual amount of wooliness or hairiness.

There are quite a number of common oaks in some portions of this eastern part, Spanish oak, Post oak, but most abundant in the upland reduced forests is *Quercus nigra* L., the dwarfed, gnarled "black jack." There are some hickories, black walnuts, cottonwoods, and elms along the river and creeks, the elms bearing abundantly large bunches of mistletoe.

A few observations as to the occurrence and habitat of some plants may be interesting. In the rich sandy land along the river bottoms the commonest shrubs are *Cephalanthus occidentalis* L., *Stillingia sylvatica* L., *Rhus copallina* L. On *Stillingia* was found an *Aecidium* which has not been yet reported on this host, as far as can be determined. Somewhat abundant in similar places were *Argemone platyceras* Link and Otto, *Callirhoe involucrata* (Nutt.) A. Gray, *Parosela enneandra* (Nutt.) Britton, *Froelichia Floridana* (Nutt.) Moq., *Indigofera leptosepala* Nutt., *Aphanostephus ramosissimus* DC. In wet, salty sand near the river were *Pluchea camphorata* (L.) DC., *Sesuvium Portulacastrum* L., and in the dry sand, *Cycloloma atriplicifolium* (Spreng.) Coulter, *Baccharis glutinosa* Pers., and *Parosela lanata* (Spreng.) Britton. The latter is reported in Gray's Man. to have "3–4 pairs" of leaflets, while 6–7 pairs were usually present on the specimens collected. On the high bluffs of the river *Yucca glauca* Nutt. was not infrequent.

In the woods which extend back from the river bottoms two or three miles are *Cassia Chamaecrista* L., *C. nictitans* L., or "sensitive plant," *Desmanthus Jamesii* T. & G., *Clitoria Mariana* L., *Gaura villosa* Torr., *Onagra biennis* (L.), Scop., *grandiflora* Lindl., a beautiful passion-flower, *Passiflora incarnata* L., *Lacinaria squarrosa* (L.) Hill, *Chrysopsis villosa* Nutt., in many of its variable forms, *Asclepias verticillata* L., and *Acerates angustifolia* (Nutt.) Dec.; also low shrubs of *Bumelia lanuginosa* (Mx.) Pers. and several species of plum. A perhaps noteworthy point was the occurrence of *Ludwigia alternifolia* L. in sandy but perfectly *dry* ravines. Gray's Manual reports the habitat of this as "swamps."

The whole prairie region is characterized by an abundance of plants belonging to the orders Leguminosae and Compositae. Particularly abundant on the prairies are *Kuhnistera multiflora* (Nutt.)

Heller, *K. purpurea* (Vent.) MacM., *Amorpha canescens* Pursh, *Parosela aurea* (Nutt.) Britt., *Solidago Missouriensis* Nutt., *Helianthus mollis* Lam., *Hieracium longipilum* Torr. The fact is significant that of the 175 species collected, 33 were Leguminosae and 32 were Compositae. *Sabbatia angularis* (L.) Pursh, *S. campestris* Nutt. and *Buechnera Americana* L. give bright colors to the prairies during June and July; *Linum sulcatum* Riddell, *Ceanothus Americanus* L., *Jatropha stimulosa* Michx., *Euphorbia corollata* L., *E. petaloidea* Eng., *E. marginata* Pursh, occur on the richer prairies, while *Megapterium Missouriensis* (Sims) Spach, *Houstonia angustifolia* Mx., *Stenosiphon linifolium* (Nutt.) Britton, *Opuntia polyacantha* Haw., and *Gerardia densiflora* Benth., are found on dry sterile prairies. A very severe case of poisoning was incurred from collecting *Euphorbia corollata.*

A very paradise for a collector of aquatic vegetation is a large pond near Perkins, Oklahoma. Several Sagittarias, *Nelumbo lutea* Pers., *Potamogeton lonchites* Tuckerm., the latter growing "rarely in ponds" (Gray's Man.), *P. diversifolius* Raf., are most abundant throughout, while near the edges *Heteranthera limosa* (Sw.) Willd., *Ludwigia glandulosa* Walt., *Monniera rotundifolia* Mx., and *Marsilia vestita* Hook. & Grev. grow rank. Some of the specimens of this Marsilia growing both in and along the banks of the pond have petioles 7–8′ long, the type being reported in the Manuals 1–4′. Dr. Underwood, however, pronounces this undoubtedly *M. vestita.*

As suggested above, the special interest of this region lies in the fact of the meeting of two floras and the sometimes abrupt, generally gradual, transition of one into the other. The flora cannot be studied comprehensively except by an extended period of field work and by carefully noting all the environmental conditions. The farther west one goes into the territory the more sandy and desert the regions become; and such are the variations from some of the more eastern forms that many are classed as varieties, no doubt the result of a change in habitat. According to Mr. Coville's suggestions in his "Botany of Death Valley Expedition," the shrubs and trees and on the prairies the perennials should especially be noted to determine the characteristic plants of the flora.

Grateful acknowledgments are due to Dr. John M. Coulter and Professor E. B. Uline for kindly determining some of the species and checking most of the list of collections.

WABASH COLLEGE, CRAWFORDSVILLE, IND.

On the two Editions of Emory's Report, 1848.

For some time past I have been aware of the fact that there were two editions of Lieut. W. H. Emory's "Notes of a Military Reconnoissance," both bearing the same date (1848); but I supposed they were identical, except that one had appended to it the reports of Abert and Cooke and the journal of Johnston. But I now possess copies of both of these books, and find that they differ in various details, which are of importance on account of Prof. Torrey's reports on the botany of the expedition.

Both editions are Executive Documents of the 30th Congress, 1st session, and they are numbered 7 and 41, respectively. No. 7 was issued for the Senate. It contains nothing but Emory's report, with its seven appendices, and consists of 416 pages. Each age has [↖] in the upper external corner. No. 41 was issued for the House. It contains the reports of Emory, Abert and Cooke, and Johnston's journal, and consists of 614 pages. "Ex. Doc. No. 41," appears in the middle of the top of each page, with the exception of pp. 145–158, in the botanical portion, which have [7] in the upper external corner. This is evidently a typographical error, and not a mistake in binding, for the pages are not the same as pp. 145–158 in No. 7.

In both of these volumes Professor Torrey's report on Emory's plants occupies pp. 135–159, constituting Appendix No. 2. My copy of No. 41 bears the following manuscript note at the top of page 135. "This appendix is full of gross typographical errors—the printer having refused to send me proof sheets according to agreement. J. Torrey." The same remark would apply with equal force to No. 7. Both books show evidence that they were published either carelessly or in very great haste. The principal differences between the two documents in the botanical portions are as follows:

1. In No. 7 Prof. Torrey's general report occupies pp. 13–5 155; page 156 contains an "Explanation of the Plates;" and on pp. 157–159 is a letter from Dr. Geo. Engelmann describing (from drawings only) the Cactaceae of the Expedition, in fine print. In No. 41 Prof. Torrey's general report occupies pp. 135–155 (but the matter on the various pages is differently distributed); Dr. Engelmann's letter extends from page 155 to page 159; and *there is no* "Explanation of the Plates."

2. In No. 41 three species are entirely omitted which are given in No. 7, viz.: (*a*) *Zinnia grandiflora Nutt.*, (*b*) *Convolvulus Nuttallii*, and (*c*) *Alternanthera?* (*Endotheca*) *lanuginosa*. Of these (*a*) and (*c*) are described, and (*b*) and (*c*) are published as new names. A person having reference to these in "Emory's Mil. Rec." and looking them up in No. 41, would be puzzled at their absence, and conclude that the references were incorrect.

3. The fourteen plates in No. 7 were lithographed by E. Weber & Co., Baltimore. Those in No. 41 are similar, but were lithographed by C. B. Graham, Washington. The latter are somewhat better (or less bad), from an artistic standpoint, but there seem to be no differences of importance—save that in No. 41 plate VI. is labeled *Baileya multiflora* instead of *B. multiradiata*.

4. In both documents Appendix No. 6, occupying pp. 386–414, consists of Lieut. Abert's "report of such objects of natural history as came under my observation while I was attached to the topographical party * * * during the journey from Fort Leavenworth to Bent's Fort. The plants which were collected were submitted to the inspection of Dr. Torrey, to whom I am indebted for their names." Prof. Torrey's list, to be found on pp. 406–414, differs somewhat in the two books, but this is of little importance, for it is a mere catalogue of names, without descriptions.

I hope that this note, published in the BULLETIN, may help to prevent trouble and confusion in the future.

JOHN HENDLEY BARNHART.

TARRYTOWN, N. Y., April 20, 1895.

Teratological Notes.

By Francis E. Lloyd.

Plate 247.

The many germinating acorns which were to be seen during the past winter in western Oregon afforded a good opportunity for studying the mode of growth of the seeds of *Quercus Garryana* Dougl. During the course of my observations a few cases of teratological interest have been noticed.

One of these is an acorn which, after having pushed its radicle out some distance, had met with a misfortune. Presumably a snail or other depredator, judging the young plant a tender morsel, had bitten into it just at the juncture of one of the petioles and the hypocotyl (Fig. I). The mouthful included the little plumule, so that further development of any or all of the remaining parts would have been in vain. The hypocotyl, nevertheless, continued to grow, the wound healing. Furthermore, the detached petiole healed and produced an incipient rootlet of its own.

In order to determine experimentally the power of the detached petiole to produce rootlets, three partly germinated acorns were chosen and a petiole and the hypocotyl in each were separated by cutting. In a few days the scars healed over, and in two of the acorns rootlets were formed, two in one (Fig. IIa) and four in the second. The third failed to grow.

Another acorn was found, from the ruptured apex of which three lengthened petioles had followed the protruding radicle. Two of these were more slender than the third, and were closely approximated at their bases. These the plumule had spread apart, pushing its way up between them. The relative positions of the three petioles can be understood from the diagram (Fig IVa) of a transverse section through the base of the plumule. It is evident that the two cotyledons with the approximated petioles are the equivalent of one in the normal seed. The earlier leaves are reduced to mere subulate bracts, and in their number and arrangement vary greatly. In these I observed no difference, except that they are more crowded in one region of the young stem, and this probably had no relation to the number of cotyledons.

A number of acorns have been found with two fertilized and developed ovules. The presence of the supernumerary seed is betrayed by the unsymmetrical shape of the acorn. The rightful occupant—if might makes right—is usually well developed, and pushes out its radicle earlier than does the intruder, which is correspondingly smaller and flattened and twisted out of shape. Occasionally, when the supernumerary seed is large, if its position is favorable it gets its radicle out of the ruptured apex first. At all events it makes a brave effort to reach soil and sunlight. A few acorns have been found in which the two plantlets had developed into two well-formed seedlings. Acorns containing more than one seed have all been found under young trees. In no case have I found such under aged trees.

Biological Laboratory, Pacific University.

Explanation of Plate 247.

Fig. 1.—"c," cotyledon; "f," foliar appendages; "p," petiole; "pl," plumule; "h," hypocotyl. The dotted lines indicate the portion excised.

Fig. 2.—The seedling after the wound had healed and the second root-tip had formed. R—original radicle; R_2—the rootlet of the cut petiole.

Fig. 2a.—A seed, the petiole of which was cut. After healing the separated petiole (p) produced two rootlets. The plumule continued to develop as seen.

Fig. 3.—Shows the end view of the seedling with three cotyledons, the petioles of which are shown in situ. The plumule (pl) projects through the smaller, paired petioles p_2 and p_3.

Fig. 4.—The same with the husk removed, and the three cotyledons outspread. The cotyledons c_2 and c_3 belong to the petioles p_2 and p_3 (in Fig. 3) respectively.

Fig. 4a.—Transverse section through the base of the plumule of Fig. 4.

Fig. 5.—An acorn with the husk removed showing the supernumerary seed in situ. Its hypocotyl (h) had grown, the radicle partially decayed and thrown off two new rootlets (a and b).

Contribution to the Characeous Plants of Maine—I.

By F. L. Harvey.

So far as we know but little attention has been given to the plants of this order by collectors in Maine; the species named in Redfield & Rand's Catalogue of the Plants of Mt. Desert being the only record we know of regarding them. We have recently been considering the few species found in the Blake Herbarium of

the Maine State College, and, adding our own observations, bring the record to date.

Research will no doubt bring to light many more species. We are under obligation to Dr. Allen for professional courtesies. We will be pleased to learn of other species occurring in the State, or to know of Maine collectors of these interesting plants.

ORDER CHARACEAE.

Family I. Nitellae.

1. *Nitella opaca* Ag.
   Blake Herb. Aroostook River (Blake), Sept., 1878.
   Redfield & Rand's Cat. Plants of Mt. Desert, p. 227.
   Common in small streams about Orono (Harvey).
2. *N. flexilis* Ag.
   Western Maine (Kate Furbish.)
   Rand & Redfield's Cat. Mt. Desert, p. 227.

Miss Furbish's plants show the monoecious fruiting and the abruptly acuminate leaves. The plants from Mt. Desert are doubtfully placed here by the editors of that catalogue.

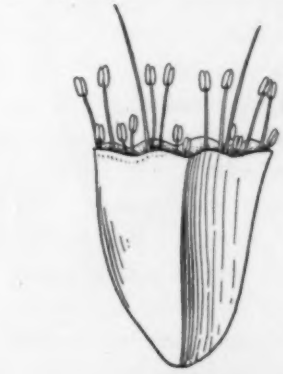
Family II. Characeae.

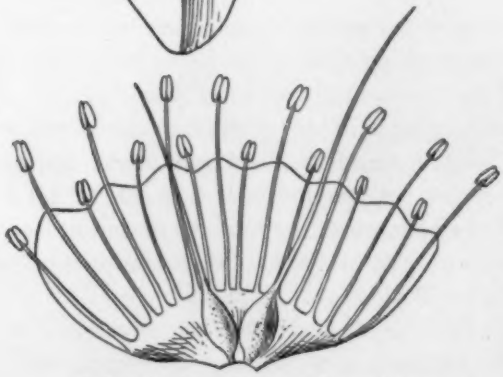
3. *Chara coronata* A. Br.
   Aroostook R., Me. (Blake) Sept. 1878.
4. *C. contraria* A. Br.
   Caribou, Me., Sept., 1878.
   The stream not mentioned in Blake's notes.
5. *C. fragilis* Desv.
   Very common in various streams in Penobscot Co. (Harvey.)

In Sunkhoze Stream, occurring on gravelly and rocky bottoms for a distance of ten miles, the patches sometimes covering the bottom of the stream for rods.

Teratological Notes.

1. *On the Stipules of Lathyrus polyphyllus.* Dr. Masters* only mentions additional stipules in the case of *Salix fragilis.* On a specimen of *Lathyrus polyphyllus* collected in California by Kellogg and Harford in 1868-1869, the lowest pair of leaflets is replaced by two stipules identical with those that subtend the rachis. The leaflets are normally alternate, but the additional stipules are opposite, as are the lower ones. About one-half of the leaves of the specimen are thus modified.





2. Polyphylly of the androecium.
3. Polyphylly of the gynœcium.

2. *On Polyphylly of the Flower of Dirca palustris.* A specimen of this species from one of the European botanic gardens shows this abnormal state in three ways.

1. Polyphylly of the calyx.

*Veg. Teratol. 357.

Many instances of the multiplication of parts in the different whorls of a flowerhave been recorded. This takes place in different ways, and one or more whorls may be affected. In the present case there seems to be a union of two flowers, making a duplication of each whorl, or polyphylly of the calyx, the androecium and the gynœcium. The undulation-like teeth of the margin of the calyx are increased from four to eight, the stamens from eight to sixteen and the pistil from one to two. The change accurs in all the flowers on the specimen and modifies the shape of the calyx from "tubular-funnelform" to campanulate.

JOHN K. SMALL.

Reviews.

Systematische Phylogenie der Protisten und Pflanzen. Ernst Haeckel. 1st Portion. Berlin. 1894.

As the author states in his preface, he has been engaged for the past thirty years upon questions pertaining to the subject-matter of this volume. All are acquainted with the "History of Creation" and have enjoyed its generalizations, and the present volume offers a rare treat to those who would advance a step and enter into generalizations based upon more specific and detailed data.

He opens with a chapter upon Phylogenie, defining it, and giving Paleontology, Ontogony and Morphology as the sources for the working-out of the problems. He rapidly and skillfully sums up the positive and negative in the geological record; discusses the value of Ontogeny and outlines the principles of Morphology. A brief review of the methods is followed by a summary of the geological systems and the first chapter, including thirty-two pages, closes with a critical review of the monophyletic and polyphyletic theories of Phylogeny.

The second chapter, fifty pages, deals with the phylogeny of the Protista, where the beginnings of life are taken up. Mr. Haeckel's familiar Monera, "Structureless organisms without organs," again does service as a starting point from which the Protista arise, in which class he groups all those organisms "which

do not build tissues;" calling those of a solitary turn of mind "Monobionten" and the more social "Coenobionten." Following the definition of the Protista, a paragraph or two is devoted to the differences in the plant and animal kingdoms. Here much stress is laid upon the synthetic character of the one and the analytic character of the other class of organisms. The plants are rechristened "Plasmodomen" and the animals "Plasmophagen" or plasma builders and plasma destroyers.

The Protista are then divided into three main groups, the atypical Protista; the plant type protista or Protophyta and the animal type protista or the Protozoa. In the first of these are included those organisms that show no particular affinity to either group, on account of an indifferent growth or because they may be at times either animal or vegetable in their functions, and are to be divided purely upon artificial grounds according to what seems to the author to be the predominant physiological activity. We note that the botanists gain the Peridineae and the zoölogists the Bacteria, which latter are said to be lacking a nucleus which, if we are not sadly mistaken, is somewhat "behind the times."

The typical Protophyta include those organisms in which

1. The cell-wall is surrounded by a special membrane which is entirely closed or has only a few openings; this membrane consisting of cellulose.

2. The cell-body is either entirely motionless throughout its life history, or, at rare intervals and in small degrees, moves about by means of flagellae, as in the swarm spores.

3. The cell is always colored, generally green or gold, and contains chromoplasts which generally contain chlorophyll, also at times diatomin, haemochromatin, etc.

4. The metabolism is entirely vegetable; the cell is "plasmodomen" and assimilates CO_2; it takes up no formed organic matter and possesses no mouth opening.

In this group are included (1) Algarien, (2) Algetten.

The pages following are too solid for abstracting, but are of interest with much philosophic thought; the phylogeny of the soul of the Protista forming an interesting extravaganza on pages 75, 76. The third chapter deals with the systematic phylogeny of the Protophyta; in this the starting point is with those atypical Pro-

tista that have a "vegetable tendency." Those without a cell nucleus, including many of the Cyanophyceae, under the name of Chromaceae begin the family tree. We can give here only the main lines of ascent, as the work is an abstract itself, and to further abstract it would out-Herod Herod. Through the Chromaceae the Algariae are reached in *Palmella*, from which Diatoms and Desmids diverge and represent radiating extremes of development in their respective lines. The Algetten, the second main class, includes many forms hitherto reckoned under the care of the zoölogists; many of the flagellate infusoria for instance. It includes all those single cell forms that have zoospores and flagellae movements: *Euglena*, *Protococcus*, *Peridinium*, *Volvox*, *Botrydium* and *Caulerpa* are included in order.

The fourth chapter treats of the Protozoa, already reviewed by the zoölogists in "Science."

The fifth chapter takes up the *general* morphology of the Metaphytes or those plants which are many-celled and tissue builders, including (a) Thallophyta, (b) Diaphyta, (c) Anthophyta. This chapter we consider the finest in the book and can be read by all botanists to some advantage independent of their interests, morphological, systematic or physiological. Chapters six, seven and eight take up the three classes respectively. The Thallophytes ascending through the Chlorophyceae, Protococcus to Confervales and branching in several directions; the Florideae, the highest branch, through *Bangia; Fucus*, through *Ectocarpus* and *Laminaria*. The Characeae a special branch through *Nitella*. The Ulvaceae to the form similar to *Riccia* and from them to chapter seven on the Diaphytes. Among the Thallophytes the fungi are represented as on offshoot from the Chlorophyceae, which is hardly tenable after Professor Farlow's well-founded suggestions upon this group, and the lichens are regarded in the Schwendenerian sense.

The Diaphytes include the Hepatics and Mosses. These are made to arise through a primitive *Riccia*, from thence through *Pellia* to the foliose forms and to *Haplomitrium* when a true axis is first reached and form this, through Sphagnums and Andreaceae or their common ancestor to the true mosses. Marchantiales and Anthoceratales are made blind alleys of growth.

The Pteridophyta are made to rise from the same ancestral Riccia-like form as the "Diaphytes," to a hypothetical "Archipterides," thence through the Hymenophyllaceae, when the stem divides into three lines, the Filices, the Equisetaceae and Lycopodiaceae, which last make the way for the Anthophyta.

These, in the closing chapter, through the Cycads and some forms similar to the fossil Noeggerathia split into a forest of stems. The Gymnosperms representing a growth through the Araucarieae, while through some forms resembling the Australian "Casaurineae" the Angiosperms were developed.

The critic would need to be a specialist in many branches, and could write a book equalling, in size, the original, if all of the interesting points touched upon were to be discussed, but to give an opinion of the work in a word, we can heartily say that a good and mighty work has been accomplished.

Upon points of classification varying points of view must always be borne in mind. Possibly the author has made a mistake in a fundamental point, upon which he devotes much space and thought to elucidate for having cautioned others not to confound Homology, form: with Analogy, function: he deliberately makes his most sweeping classes and distinctions upon a purely physiological, hence functional basis.

The numerous points of difference which would interest workers in special fields can not be discussed here, but the work is to be recommended to all readers as one of more than common interest.

SMITH ELY JELLIFFE.

Volume I., of Anton Kerner von Marilaun's *Pflanzenleben*, translated by Prof. F. W. Oliver as *The Natural History of Plants*, has recently been issued from the press of Henry Holt & Co. This work will be warmly received by all lovers of nature. In a style simple, attractive and still thoroughly scientific, Professor von Marilaun considers in this first volume: The Living Principle in Plants, Absorption of Nutriment, Conduction of Food, Formation of Organic Matter from the Absorbed Inorganic Food, Metabolism and Transport of Materials, Growth and Construction of Plants and Plant-forms as Completed Structures.

Under there captions are discussed in a most charming man-

ner hundreds of interesting biological questions that have been practically excluded from the attention of very many people through the technicality of authors. Now, indeed, for the first time, are thrown open wide the gates to the natural history of plants and all may enter and enjoy the wide range of the whole field. The above mentioned seemingly unattractive subjects are invested with a charm that must arouse the enthusiasm of all. Thus under the rather unattractive title of Absorption of Nutriment, is discussed, among many other subjects, the adjustment of leaves to the welfare of the root; plants with traps and pitfalls to ensnare animals. So also under conduction of food a chapter is given to all those wonderful adaptations whereby the plant may suffer no inconvenience from untoward external conditions that would interfere in any way with its life current; and then again are taken up those adjustments of branches and that exquisite moulding of leaf forms and their relation to the branches whereby the best interests of the plant are subserved, and in this connection follows a discussion of the protection of leaves against the attacks of animals. The work is in a sense exhaustive, copiously illustrated, the wood engravings especially being excellent, and the translator reflects most happily the spirit of the author. C. C. CURTIS.

The London Catalogue of British Plants. The recent publication of the ninth edition of the list of higher plants growing naturally in Great Britain and Ireland (the Characeae are appended), affords opportunity for ascertaining just how widely British botanists differ from our recently issued "List of Pteridophytes and Spermatophytes" in the nomenclature of genera. From the statements of some writers one might be lead to infer that the disagreements would be very numerous, but it appears that this is not the case.

The total number of genera listed in the English publication, exclusive of the Characeae, is 538. The "List of Pteridophyta and Spermatophyta growing without cultivation in eastern North America" contains 970. Allowing for differences in generic limitations, the London Catalogue sometimes uniting genera which the "Check-list" holds distinct, and *vice versa*, there are about

440 genera in common, all but 18 of which bear the same names. I have indicated these in the following table:

Check-list.	London Catalogue.
Capnoides Adans. 1763.	*Neckeria* Scop. 1777 (1).
Roripa Scop. 1760.	*Nasturtium* L. 1735 (2).
Alsine L. 1753.	*Stellaria* L. (3).
Tissa Adans. 1763.	*Buda* Adans. 1763 (4).
Spiesia Neck. 1790.	*Oxytropis* DC. 1802 (5).
Sanguisorba L. 1753.	*Poterium* L. (6).
Silybum Gaertn. 1788.	*Mariana* Hill, 1762 (7).
Legouzia Durand, 1782.	*Specularia* Heist. 1748 (8).
Limonium Adans. 1763.	*Statice* L. (9).
Statice L. 1753.	*Armeria* L. (10).
Udora Nutt. 1818.	*Elodea* Michx. 1803 (11).
Leptorchis Thouars, 1808.	*Liparis* L. C. Richard, 1818 (12).
Gyrostachys Pers. 1807.	*Spiranthes* L. C. Richard, 1818(13).
Peramium Salisb. 1812.	*Goodyera* R. Br. 1813 (14).
Juncoides Adans. 1763.	*Luzula* DC. 1805 (15).
Savastana Schrank, 1789.	*Hierochloë* S. G. Gmelin, 1747. (16).
Panicularia Fabric. 1763.	*Glyceria* R. Br. 1810 (17).
Dryopteris Adans. 1763.	*Polystichum* Roth, 1794 (18).

Notes.

1. Both lists thus reject *Corydalis* Vent. 1803. While the British botanists were taking up another name, it seems strange that they could not accept *Capnoides*, which is quite as well defined as any of the rest of Adanson's genera, and of these they have admitted a considerable number: *Meum*, *Arctostaphylos*, *Cicendia*, *Epipactis*, *Polygonatum*, *Mibora*, *Apera*, for example.

2. The Linnaen use of *Nasturtium* is confined to the first edition of his "Systema," published in 1735. He did not use it subsequently and it was only again taken up by R. Brown in 1812. Meanwhile *Roripa* had been published and well defined. The American rejection of *Nasturtium* is thus based on the Rochester agreement, adopted by the Genoa congress, and more recently approved by the Austro-German botanists, to begin generic nomenclature at 1753.

3. Here, again the "starting-point" for generic names comes into consideration, and *Alsine* has precedence of place in the first edition of the "Species Plantarum," both genera being recognized in that work. It appears possible to me that both genera will again be recognized, *Alsine* for *A. media* and its relatives and *Stellaria* for such types as *S. graminea*.

4. Both lists thus reject *Spergularia* Presl, and *Lepigonum* Wahl. *Tissa* has

precedence of place in Adanson's "Familles des Plantes" and is accepted by Baillon in his "Histoire" and by Pax in Engler-Prantl's "Natürliche Pflanzenfamilien."

5. Necker's name for this genus is satisfactorily identified by the description; I have been unable to discover any reason under any set of principles which really warrants its rejection. The authors of the London Catalogue have admitted *Boretta* proposed by him. Why not *Spiesia*?

6. *Poterium* L. is considered, and in my opinion correctly, by European authors, as monotypic, including only *P. spinosum* L. of southern Europe.

7. This is a case in which the London Catalogue is right, and the American list wrong, under all rules, and we should be grateful for the correction. The citations are MARIANA Hill, Veg. Syst. 4: 19. 1762. *Mariana Marianum* (L.) Hill, Hort. Kew. 61. 1769. Hill's use of duplicate binomials is the earliest which has come to my attention; he proposed a number of others in the same publication.

8. *Specularia* Heist. was taken up by no subsequent author until employed by Alphonse DeCandolle in 1830. The 1753 "starting point" excludes it. Meanwhile *Legousia* had been published and the genus defined.

9–10. In adopting *Statice* L. for *S. Armeria* L. and its allies, and *Limonium* Adans. for *Statice Limonium* and its congeners, the American list returns to the use of *Statice* in the "Species Plantarum" of 1753, in which the genus *Armeria* was not taken up. The use of these generic names, as adopted in the London Catalogue, dates only from their publication by Willdenow, 1809.

11. *Elodea* was regarded by the American committee as a homonym of *Elodes* Adans. 1763. I have recently discussed this point (Science, n. s., 2: 5. 1895), showing that *Philotria* Raf., has a few months' priority over *Udora*. It will be noted that both lists reject *Anacharis*.

12. The validity of publication of Du Petit Thouars' genera of Orchidaceae has been questioned, but also ably defended. I have not had access to his paper.

13. There can be no doubt as to Persoon's intention in proposing the name *Gyrostachys* (*Gyrostachis* in original), as he refers to *Ophrys spiralis* L., to illustrate it; this species is included in *Spiranthes* by recent authors.

14. There can be no possibility of mistaking Salisbury's meaning in the publication of *Peramium*, for he bases it on one of the same species cited by R. Brown under *Goodyera* a year later. It is true that Salisbury published no description of the the genus; but many other widely accepted genera rest on just this form of publication.

15. My remarks under *Capnoides* apply equally well to this. Perhaps the compilers of the London Catalogue objected to the termination *oides*, but they have good authority for its use in the publication by Benthan and Hooker (Genera, 2: 301) of *Mniodes* A. Gray, and this is also accepted in the Kew Index.

16. Gmelin's name antedates the first edition of "Species Plantarum" and was not again used until after the publication of *Savastana*.

17. I have not seen the original publication of Fabricius, but *Panicularia* and *Glyceria* are cited as equivalent by Kuntze.

18. Both lists thus reject *Aspidium* Sw. 1800. It should be added that the London Catalogue recognizes *Polystichum* Roth, and *Lastraea* Presl, as genera.

The percentage of difference in the two lists is 4.09 per cent.

The changes of generic names in the ninth edition of the London Catalogue, from those used in the eighth edition, published in 1886, and which agree with the American catalogue, are as follows:

Nymphaea L., 1753, for *Nuphar* Sibth. & Smith, 1808.
Castalia Salisb., 1805, for *Nymphaea* J. E. Smith, 1806.
Bursa Weber, 1780, for *Capsella* Medic., 1792.
Coronopus Gaertn., 1791, for *Senebiera* DC., 1799.
Schollera Roth, 1788, for *Oxycoccus* Pers., 1805.
Pneumaria Hill, 1762, for *Mertensia* Roth, 1797.*
Homalocenchrus Mieg., 1768, for *Leersia* Sw., 1788.
Weingaertneria Bernh., 1800, for *Corynephorus* Beauv., 1812.
Sieglingia Bernh., 1800, for *Triodia* Beauv., 1812.

It would appear, from a consideration of these comparisons, that the British botanists were, after all that has been said, gradually coming to recognize the validity of the principle of priority, in at least generic nomenclature. There also appears to be no good reason why this process should not continue, so that by the time of the issue of the tenth edition of their useful list the percentage of difference might be reduced to 2 per cent. or perhaps less.

For, if the recognition of this principle had been complete, and the 1753 "starting-point" had been accepted, not more than six of the genera would have borne different names. N. L. B.

Among Rhode Island Wild Flowers. By W. Whitman Bailey. Providence, R. I. Preston and Rounds. 1895. Cloth. 16 mo. pp. 105.

Under the above title, Prof. Bailey has grouped a number of chapters which we may well designate as bits of floral poetry, written in prose. The author does not attempt to give a list of Rhode Island plants, but to call attention to the fact that the flowers of the State are of surpassing beauty and interest. Rhode Island lies on the line dividing our northern and southern floras, and hence contains many interesting forms.

After an introduction, we have a scheme of plant distribution, showing the wide variation of plant life, in plants of the salt water, the salt marsh, the river, the sea beach, the bog, the forest and the

* The American publication maintains *Pneumaria* and *Mertensia* as distinct genera.

like. Nearly half the book is taken up with a description of the Favored Spots, and this constitutes the chief charm. A few choice plants are mentioned in each case, while a delightful picture of the locality is presented, enticing the botanist to visit the spot and search for the treasures growing there. Especially interesting is the chapter on Wild Flowers of Block Island, where the presence or the absence of certain forms is suggestive of speculation as to the distribution of plants. The weeds of the State claim a separate discussion. Interesting to a botanist they are, as Prof. Bailey says, "A flower garden is lovely; but for vital, every-day, continual interest, a weed-grown yard is far-and-away more fascinating."

A list of Rhode Island trees is appended. We welcome the little book, for it cannot fail to fill its readers with a love for our wild flowers in general. WALTER DEANE.

Proceedings of the Botanical Club, A. A. A. S., Springfield Meeting, August 29th to September 2d, 1895.

The meetings were held in the room assigned to Section "G," in the State Street Baptist Church.

THURSDAY MORNING, AUGUST 29TH.

In the absence of the President, Prof. D. H. Campbell, and of the Secretary, Prof. F. C. Newcombe, the meetings of the Club were placed in organization by Prof. Geo. F. Atkinson. Hon. David F. Day was made Chairman pro tem. and Prof. H. L. Bolley, Secretary.

On motion of Professor Atkinson, those having papers to present were requested to hand titles of the same to the Secretary upon the day preceding that upon which it was wished the paper should be read.

The meeting adjourned at 11:30 to meet at 9 A. M., Friday, August 30th.

FRIDAY MORNING, AUGUST 30TH.

The Club met as ordered, with President D. H. Campbell in the chair. In order to facilitate the reading of papers, the titles of

which for the first time in the history of the Club now appeared printed in the regular daily program of the A. A. A. S., the reading of the minutes of the previous meetings was dispensed with.

The first paper presented was on "Crimson Clover Hair-balls," by Mr. F. V. Coville. These balls, composed of the hairs of the Crimson Clover, *Trifolium incarnatum*, had been found in the stomach of a horse. Mr. Coville exhibited specimens, also mounted slides showing their composition.

Professor Byron D. Halsted reported the results of field experiments with beans. He had found that 25 per cent. of plants grown on soil previously occupied by beans were affected by spot, whereas when grown on new soil only 6 per cent. were diseased.

Mrs. Elizabeth G Britton reported corrections upon descriptions of *Coscinodon*.

Mr. O. F. Cook remarked upon "A peculiar Habit of a Liberian Species of *Polyporus*," and exhibited specimens showing various degrees of prolification, one pileus arising from another upon very extended delicate stalks, due perhaps, to the extreme moisture of their environment.

An apparatus for the bacteriological sampling of well-water was described and illustrated by Professor H. L. Bolley, the merits of which were facilities afforded for sterilization in toto, and in general accuracy of work afforded without contamination by air and water.

Mr. C. L. Pollard described the methods of work in the National Herbarium. The colored labels in use to designate type specimens were of especial interest, because of the new range offered for convenience of reference.

Passing to order of unfinished business Dr. Trelease called for the report of the committee appointed at the Rochester meeting to prepare and print a check list of the plants of northeastern North America. Dr. N. L. Britton, as chairman of the committee, submitted the appended report:

"The committee reports that it has completed the task assigned it by the Club at its Rochester and Madison meetings, by preparing, to the best of its ability, a list of plants in accordance with instructions received at those meetings. The committee

herewith presents a printed copy of such list, which has been prepared and published without expense to the Club.

"For the committee,

"N. L. BRITTON,

"*Chairman.*"

Mr. O. F. Cook, seconded by Dr. F. H. Knowlton, moved the acceptance of the report. After some discussion as to the scope of the term "acceptance" as here moved, an adjournment was taken until afternoon without action being taken upon the motion.

FRIDAY AFTERNOON, AUGUST 30TH.

Following the regular session of Section "G" the Club, upon further discussion, adopted the motion of Mr. Cook to accept the report.

On motion of Prof. L. H. Bailey the Club then proceeded to the discussion opened in the morning by passing the regular program.

On motion of Mr. F. V. Coville, seconded by Prof. E. L. Greene, and carried, it was resolved that the meeting proceed to a discussion of the principles on which the list was based.

Dr. B. L. Robinson then alluded to certain generic names which he thought had been inconsistently employed in the list. He also discussed the admission of specific names first published as synonyms; the practice of admitting such names was defended by Prof. Greene, who maintained that the practice of "taking up of synonyms" as used by the committee was a principle established by Gray.

Professor N. L. Britton also maintained that the principles adopted by the Club at the Rochester meeting required the admission of such synomyms as those cited by Dr. Robinson.

After much rambling discussion the following resolution offered by Professor Britton, and seconded by Professor L. H. Bailey, was adopted:

Resolved, That in view of the opinions which have been expressed at home and abroad on principles of nomenclature, during the progress of the work of the committee, the matter be referred to the committee for consideration and report at the next meeting of the Club.

Prof. Britton also introduced the following resolution:

Resolved, That the committee be increased to eleven members by the additions of Dr. B. L. Robinson and Dr. C. S. Sargent.

At this point Dr. B. L. Robinson stated that because of the radical difference of opinion existing between himself and the majority of the present committee upon certain vital points, it was plain to him that he must decline to serve upon the committee. In compliance with these wishes, the Club reluctantly accepted Dr. Robinson's withdrawal, and upon motion, Professor L. H. Bailey's name was substituted in the resolution, and the same adopted as amended. The Club then adjourned to meet at the same place at 9 A. M., Monday, September 2d.

Monday Morning, September 2d.

Prof. N. L. Britton, Dr. W. H. Seaman and Mr. Walter Deane were appointed a committee to nominate officers for the next meeting.

The report of Treasurer F. C. Newcombe, showing the balance in hand, $6.57, was read and accepted, as here appended:

Ann Arbor, Mich., August 26, 1895.

BOTANICAL CLUB, A. A. A. S.

Report of the Treasurer for the year ending August 26, 1895.

1894.	RECEIPTS.	
August 17.	Voluntary contributions from members present at Brooklyn	$7.32
1895.	DISBURSEMENTS.	
August 26.	Express charges on records, Ann Arbor to Springfield	.75
	Balance on hand, ...	6.57

The first paper was read by Mrs. Elizabeth G. Britton, entitled "Some Notes on *Dicranella heteromala* and allied Species."

Prof. J. C. Arthur described a new form of clinostat, and remarked on its advantages over similar machines previously constructed, its great superiority being multiple arms for holding plants, allowing of checks upon tests made.

A paper by Mr. A. B. Seymour describing the Mary A. Gilbreth collection illustrating the dissemination of seeds, now the property of Radcliffe College, was read by Mrs. Flora W. Patterson.

Judge David F. Day described the dissemination of the seeds of *Zinnia* by means of the persistent ray-flowers.

Mr. Walter Deane mentioned the expulsion of the seeds from the capsules of the Witch-hazel, *Hamamelis Virginica*, stating that he had observed them strike a pane of glass fourteen feet away with almost force enough to crack it.

Judge Day spoke also on the desirability of further observations on climbing plants, referring to his observations on the genus *Dioscorea*, some species of which twine in one direction, others in another. He mentioned *Aconitum uncinatum* as a twining plant, and had observed a secondary peduncle in *Anemone Virginiana* twining around the primary one.

The following papers were read by title during the meetings:

"Notes upon Pig-nut Hickories," by William Trelease.

"Experiments with Lime as a preventive of Club-root," by B. D. Halsted.

"Notes on the alkaline Reaction of the vascular Juices of Plants," by Erwin F. Smith.

"Continuation of Experiments upon the Relation between the fertile and sterile Leaves of *Onoclea*," by George F. Atkinson.

"A Hybrid between an Egg Plant and Tomato Plant," by P. H. Rolfs.

"A Method of using Formalin Gelatine as a Mounting Medium," by A. F. Woods.

The committee appointed to nominate officers submitted the following names and they were unanimously elected:

President, Frederick V. Coville, Washington, D. C.

Vice-President, Conway MacMillan, Minneapolis, Minn.

Secretary and Treasurer, J. F. Cowell, Buffalo, N. Y.

The Secretary was requested to append to the minutes for future reference, a list of persons who have been officers of the Club, since its formation.

The Club then adjourned to meet as usual during the meeting of the Association in 1896.

Fifty-three botanists were registered during the different sessions.

H. L. Bolley,
Secretary pro tem.

Titles of Papers read before the Section of Botany, A. A. A. S., Springfield Meeting.

The following were presented either in full, in abstract or by title. A summary of the proceedings may be found in the September issue of the "Botanical Gazette."

A Leaf Rot of Cabbage. By H. L. RUSSELL.

The Southern Tomato Blight. By ERWIN F. SMITH.

Observations on the Development of *Uncinula spiralis*. By B. T. GALLOWAY.

The Effect of Sudden Changes of Turgor and of Temperature on Growth. By RODNEY H. TRUE.

Recording Apparatus for the Study of Transpiration of Plants. By ALBERT F. WOODS.

Pressure, Normal Work and Surplus Energy in Growing Plants. By GEORGE M. HOLFERTY.

Notes on the Ninth Edition of the London Catalogue of British Plants. By N. L. BRITTON.

Obolaria Virginica L. A Morphological and Anatomical Study. By THEO. HOLM.

Botany of Yakutat Bay, Alaska. By FREDERICK V. COVILLE.

Variation after Birth. By L. H. BAILEY.

Rejuvenation and Heredity. By CHAS. S. MINOT.

The Distinction Between Animals and Plants. By J. C. ARTHUR.

Fungous Gardens in the Nests of an Ant, *Atta tardigrada* Buckl., near Washington, D. C. By WALTER T. SWINGLE.

Poisoning by Broad-leaved Laurel, *Kalmia latifolia*. By FREDERICK V. COVILLE.

The Physiology of *Isopyrum biternatum* L. D. T. MACDOUGAL.

The Transmission of Stimuli-effects in *Mimosa pudica* L. By D. T. MACDOUGAL.

Personal Nomenclature in the Myxomycetes. By O. F. COOK.

A New California Liverwort. By DOUGLAS H. CAMPBELL.

The Number of Spore Mother Cells in the Sporangia of Ferns. By WILLIS L. JEPSON.

The Constancy of the Bacterial Flora of Fore Milk. By H. L. BOLLEY.

The Watermelon Wilt and other Wilt Diseases due to *Fusarium*. By ERWIN F. SMITH.

Antidromy in Plants. By GEORGE MACLOSKIE.

Proceedings of the Botanical Society of America, Springfield Meeting, Aug. 26th and 27th, 1895.

The botanists conducted their sessions at the meeting of the Botanical Society of America with Prof. Wm. Trelease, President, in the chair, and Prof. C. R. Barnes, Secretary. They elected Prof. C. E. Bessey, President; Prof. W. P. Wilson, Vice-President; Prof. C. R. Barnes, Secretary, and Mr. Arthur Hollick, Treasurer, for the ensuing year. They also elected Dr. A. W. Chapman an honorary member; and Mr. M. S. Bebb, Prof. W. R. Dudley, Prof. D. P. Penhallow and Prof. W. A. Setchell as active members. It was decided to deposit such books and pamphlets as may be received for the Society, in the Library of the Missouri Botanical Garden.

Most of the papers presented were brief summaries of larger works and enterprises, on which the authors are engaged.

Mrs. N. L. Britton read a paper on "Some Notes on a Revision of the genus *Mnium*," in which an attempt was made to show how nearly the American specimens correspond with European types and descriptions.

Dr. N. L. Britton gave a brief account of the history of the founding of the New York Botanical Garden, describing the site in Bronx Park and outlining the plans of the board of managers.

Prof. L. H. Bailey presented the following resolution which was passed unanimously:

"*Resolved*, That the Botanical Society of America express its thanks to Dr. N. L. Brinton for his account of the condition and progress of the movement for a botanical garden in the City of New York, and congratulate the people of that city on the prospect of its rapid development; and, furthermore, that the Society commend the board of managers of the garden and its board of scientific directors for their wisdom in securing a broad foundation and an assurance of liberal management."

Prof. George F. Atkinson presented a paper as a contribution to the knowledge of North American phycophilous fungi.

Mr. Arthur Hollick exhibited a series of plates illustrating the fossil leaves of *Liriodendropsis*, contrasting them with the stages of development of the leaves in *Liriodendron*, showing that there is a parallelism between the shapes of the earliest rudimentary leaves of the living species with that of the development of the fossil ones.

Prof. Roland Thaxter exhibited the plates of a monograph on the Laboulbeniaceae which he is preparing, explaining the structure of these minute fungi, which grow on living insects, and describing several new genera and species. He also made a few remarks on the phycomycetous fungi, and showed diagrams of one new genus and species.

Mr. F. V. Coville gave a brief abstract of his revision of the genus *Juncus*, subdividing it into subgenera, and recognizing seventy-six species in North America.

Prof. Chas. R. Barnes made remarks on a revision of the genus *Dicranum* which he is preparing, with the assistance of Mr. Rodney H. True, recognizing thirty-three North American species, and explaining his reasons for rejecting several recently described.

Index to recent Literature relating to American Botany.

Anderson, A. P. The Grand Period of Growth in a Fruit of *Cucurbita Pepo*, determined by Weight. Bull. Geol. Nat. Hist. Surv. Minn. 9: 238–279. *pl. 11–20.* 5 Mr. 1895.

Bessey, C. E. A Protest against the "Rochester Rules." Am. Nat. 29: 666–668. Jl. 1895.
Opposes the Harvard herbarium recommendations.

Bessey, C. E. Progress of the Botanical Survey of Nebraska. Am. Nat. 29: 580–582. Je. 1895.

Bolander, H. N. A new *Erythronium*. Eryth. 3: 127. 15 Au. 1895.
Erythronium Johnsonii from southern Oregon.

Coulter, J. M. and **Rose, J. N.** *Deanea*, a new Genus of Umbelliferae from Mexico. Bot. Gaz. 20: 372. *pl. 27.* 15 Au. 1895.

Coville, F. V. *Juncus scirpoides* and its immediate Relatives. Bull. Torr. Bot. Club, **22**: 302–305. 31 Jl. 1895.

Davenport, G. E. Daniel Cady Eaton. Bot. Gaz. **20**: 366–369. *pl. 26 A.* 15 Au. 1895.

Greene, E. L. Novitates occidentales.—XVI. Eryth. **3**: 123–126. 15 Au. 1895.
Describes new species in *Clarkia*, *Eriophyllum*, *Erigeron*, *Allocarya* and *Calliprora*.

Holm, T. A Study of some anatomical Characters of North American Gramineae.—IV. Bot. Gaz. **20**: 362–365. *pl. 26.* 15 Au. 1895.
Describes the leaf-structure of *Leersia*.

Holzinger, I. M. A Preliminary List of the Mosses of Minnesota. Bull. Geol. Nat. Hist. Surv. Minn. 9: 280–294. 5 Mr. 1895.

Jack, J. G. Another Herbarium Pest. Gard. & For. **8**: 323–324. *f. 45.* 14 Au. 1895.
Illustrating and describing *Ephestia interpunctella*.

Jack, J. G. The Hazels. Gard. & For. **8**: 344–346. *f. 48.* 28 Au. 1895.
Notes on *Corylus rostrata*.

Johnson, L. N. Some new and rare Desmids of the United States.—II. Bull. Torr. Bot. Club, **22**: 289–298. *pl. 239, 240.* 31 Jl. 1895.
Describes new species in *Arthrodesmus*, *Cosmocladium* and *Cosmarium*.

Kellerman, W. A. On Plant Names. Journ. Columbus Hort. Soc. **10**: 7–10. Mr. 1895.
Maintains the necessity of adherence to priority.

La Mance, L. S. *Iris hexagona.* Gard. & For. **8**: 329. 14 Au. 1895.
Recording the discovery of *Iris hexagona La Mance* Gerard, in Benton County, Arkansas.

Lotsy, J. P. Some Euphorbiaceae from Guatemala. Bot. Gaz. **20**: 348–355. *pl. 24, 25.* 15 Au. 1895.
Describes a number of new species.

Magnus, P. Die Teleutosporen der *Uredo Aspidiotus* Peck. Ber. Deutsch. Bot. Gesell. **13**: 285–288. *pl. 23.* 25 Jl. 1895.

Mez, C. Einige Bemerkungen über *Nidulariopsis*. Ber. Deutsch. Bot. Gesell. **13**: 236–239. 25 Jl. 1895.

Nash, G. V. The Genus *Cenchrus* in North America. Bull. Torr. Bot. Club, **22**: 298–302. 31 Jl. 1895.

Pammel, L. H. Some troublesome Iowa Weeds. Rep. Iowa Agric. Soc. **1894**: 523–539. 1895.

Figures of *Salsola Kali* var. *Tragus*, *Arctium Lappa*, *Xanthium Canadense*, *Ambrosia trifida*, *Hordeum jubatum*, *Capsella Bursa-pastoris*, *Cuscuta Epithymum*, with accounts of these weeds.

Pammel, L. H. The Geographical Distribution of Plants. Rep. Iowa State Hort. Soc. **29**: 324–433. 1895.

Penhallow, D. P. *Rhus* Poisoning. Gard. & For. **8**: 359. 4 S. 1895.

Robinson, B. L. The Nomenclature Question. Bot. Gaz. **20**: 370–371. 15 Au. 1895.

Rolfe, R. A. New Orchids. Kew Bull. 104: 191–195. Au. 1895.

Tropical American species in *Pleurothallis*, *Batemaria*, *Maxillaria*, *Notylia* and *Pelexia*.

Rolfe, R. A. *Vanillas* of Commerce. Kew Bull. 104: 169–178. Au. 1895.

An historic and descriptive account of the species yielding aromatic fruits. Two are described as new.

Rydberg, P. A. New Species of *Physalis*. Bull. Torr. Bot. Club, **22**: 306–308. 31 Jl. 1895.

Sadebeck, R. Einige neue Beobachtungen und kritische Bemerkungen über die Exoascaceae. Ber. Deutsch. Bot. Gesell. **13**: 265–280. *pl. 21*. 25 Jl. 1895.

References to many American species.

Sargent, C. S. The American White Birches. Gard & For. **8**: 355. *f. 50*. 4 S. 1895.

Note on *Betula populifolia* and *B. papyrifera*.

Setchell, W. A. On the Classification and Geographical Distribution of the Laminariaceae. Trans. Conn. Acad. Arts and Sci. **9**: Part 2, 333–375. 1895.

Sheldon, E. P. Compilation of Records of some Minnesota Flowering Plants. Bull. Geol. Nat. Hist. Surv. Minn. 9: 223–227. 5 Mr. 1895.

Smith, J. B. Why certain Hickories died. Gard. & For. **8**: 352–353. *f. 49*. 4 S. 1895.

Tilden, J. E. List of fresh-water Algae collected in Minnesota during 1894. Bull. Geol. Nat. Hist. Surv. Minn. 9: 228–237. 5 Mr. 1895.

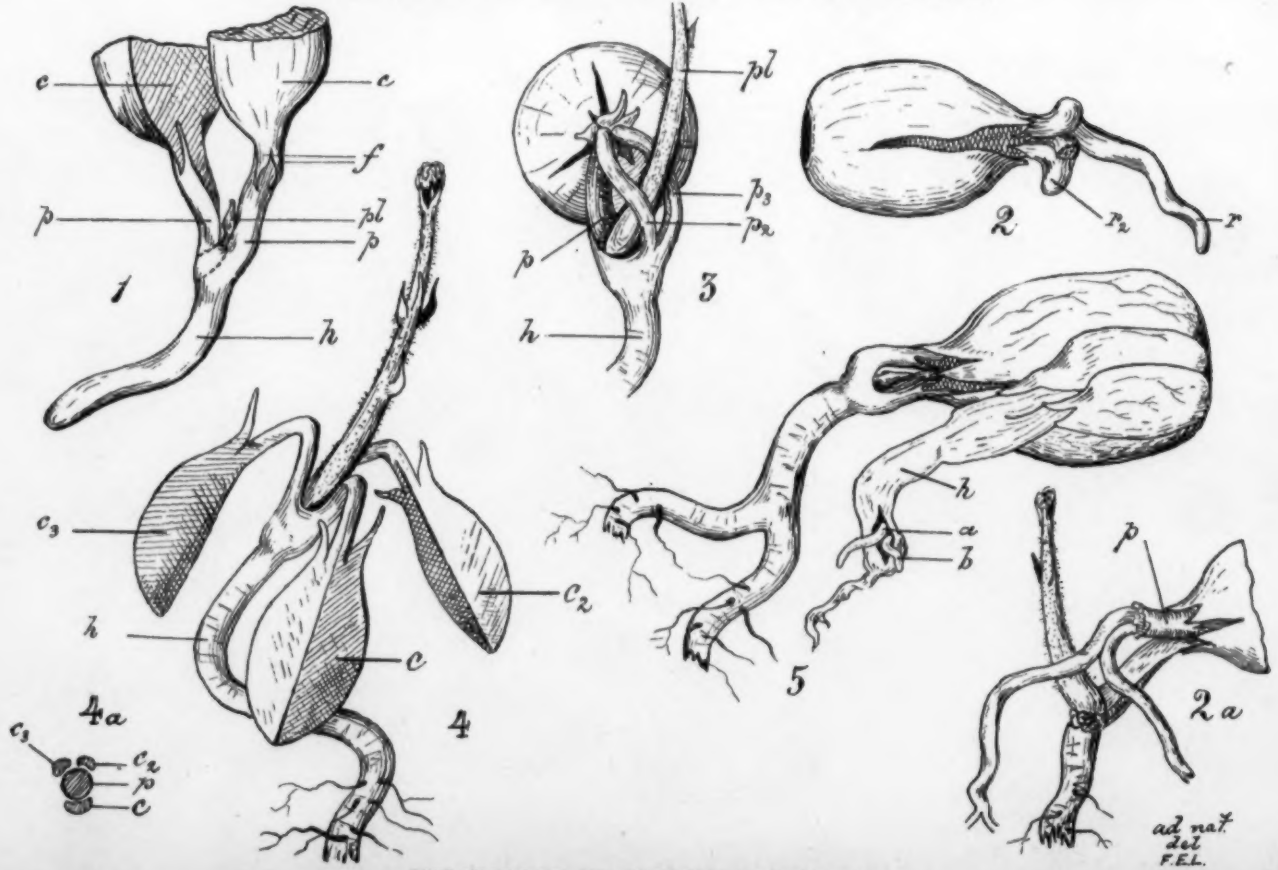
Toumey, J. W. *Opuntia fulgida*. Gard. & For. **8**: 324–326. *f. 46*. 14 Au. 1895.

Toumey, J. W. Vegetal Dissemination in the Genus *Opuntia*. Pot. Gaz. **20**: 356–361. 15 Au. 1895.

Uline, E. B., and **Bray, W. L.** Synopsis of North American *Amaranthaceae*—III. Bot. Gaz. **20**: 337–344. 15 Au. 1895.

Ward, F. L. The Nomenclature Question. Bull. Torr. Bot. Club, **22**: 308–329. 31 Jl. 1895.

Wilcox, E. M., Chairman. Report of the Committee on Botany. Journ. Columbus Hort. Soc. **10**: 5. Mr. 1895.
Record of species of *Polyporus* near Columbus, Ohio.



TERATOLOGY IN QUERCUS GARRYANA.

Surplus Books for Sale from the Library of Dr. M. C. Cooke.

146 Junction Road, London N., England.

Balfour, J. B. Botany of Socotra. 4°. 100 plates. Edinburgh.
Hedwig. Theoria generationis and Hist. Nat. Muscorum. 4°.
Lamarck and DeCandolle. Flore Francaise. 6 vols., 8°.
Steudel. Nomenclator Botanicus. 8°, board.
Linnaeus. Flora Suecica. First Edition.
Leers. Flora Herbornensis. 16 pl., 8°.
Acharius. Synopsis Lichenum.
Marsilius. Dissert: de generatione Fungorum.
Retz. Observationes Botanicae. Folio.
Vaillant. Botanicon Parisiense. Folio.
Queckett. Histological Catalogue. 4°. 2 vols., cloth.
Luerssen. Medico-Pharmaceutik Botanik. Vol. 1, Kryptogamen, 8°, paper.
Lindley, Dr. Flora Medica. 1 vol., cloth.
Waring, Dr. Pharmacopaeia of India. 8°, cloth.
Fluckiger, Dr., and Hanbury, D. Pharmacographia. 8°.
Hanbury, D. Notes on Chinese Materia Medica.
Hanbury, D. Science Papers. 1 vol., 8°.
Waring, Dr. Bibliotheca Therapeutica. 2 vols., 8°.
Christison, Dr. On Poisons. 8°, 1 vol.
Allen and Thomson. Expedition to the Niger. 8°, 2 vols.
Farlow, W. G. Marine Algae of New England. 8°, paper.
Toni and Levi. Flora Algologica Venezia. Parts I. and III.
Toni and Levi. L' Algarum Zanardini. 8°.
Underwood. Catalogue of N. Am. Hepaticae. 8°.
Tuckerman. Synopsis of Lichens of New England.
Bescherelle. Prodromus Bryologiae Mexicanae. 8°.
Harvey, Dr. Phycologia Britannica. 4 vols. in 2 half morocco, gilt tops. Splen did copy, first issue.
Sowerby's English Botany. 2d Edition, Vol. XII., only containing Algae. 8° cloth.
Goebel, K. Morphologische und Biologische Studien. 8°, 15 plates.
Queckett, J. Lectures on Histology. 2 vols., 8°, cloth.
Queckett, J. Treatise on the Microscope. 8°, cloth.
Humboldt. Flora Friburgensis. 4°, board.
Ardissone. Enum. della Alghe della Marca di Ancona. 4°
De Notaris. Epilogo della Briologia Italica. Roy. 8°, half calf.
Wahlenberg. Flora Suecica. 2 vols. 8°.
Bauhin. Theatrum Botanicum. Folio.
Meyer. Primitiae Florae Essequeboensis. 4°, calf.
Sullivant. Musci and Hepaticae of U. S. 8°.
Kickx, J. Flore cryptogamique des Flandres. 2 vols. in 1. Half calf. 1867.
Roth, A. G. Catalecta Botanica. 3 vols., 8°, half calf. 1806.
Schrader, H. Spicilegium Florae Germanicae. 8°. 1794.
Haller, A. Flora Jenensis. 12°. 1745.
Weigel. Flora Pomerano Rugica. 12°. 1769.
Olhaff. Elenchus Plantarum. 12°. 1656.
Sprengel, C. Florae Halensis. 8°. 1806 and 2 suppl.
Schumacher. Plantae Saellandiae. 2 vols., 1801.
Schlechtendal. Flora Berolinensis. Part 2, Cryptogamia. 1824.
Wulff, J. C. Flora Borussica. 12° 1765.
Schrank. Florae Salisburgensis. 12. 1792.
Weinmann. Enum: Stirpium in Agro Petropolitano. 8°. 1837.
Martius. Flora Erlangensis Crypt. 8, 6 pl., 1817.

Nuovo Giornale Botanico Italiano, 1872 to 1891. 20 years complete, 18 in 9½ calf, rest in parts.

Michelia. Ed. P. A. Saccardo, 1879 to 1882 in 2 vols., half calf (all published).

Hedwigia (Ed. Rabenhorst, etc.), 1852 to 1891 (Vol. II. imperfect) together in 15 vols., cloth).

Flora (Regensburg), vols. 34 to 47. 14 vols., cloth.

Notarisia, Commentarium Phycologiae, 1886–1891. Parts 1 to 25 (wanting part 21).

La Nuova Notarisia. 1890–1891. 7 parts.

Revue Mycologique (Roumeguere). 1888–1891. 13 vols. in 6, cloth.

Rabenhorst's Algae Europaea Aquae dulces. 3 parts in 2 vols., half calf, complete, 1864.

Monthly Microscopical Journal. (Ed. Dr. Lawson.) 18 vols., cloth. 1869–1877.

Grevillea (Ed. M. C. Cooke). Complete set in parts, 20 vols., 1872–1892. Complete sets out of print.

Hassalls, Dr. British Fresh Water Algae. 2 vols., cloth.

Smith, W. British Diatomaceae. 2 vols., cloth.

Ralfs, J. British Desmidiae. 1 vol., half calf.

Bornet et Thuret. Notes Algologiques, part 2 only, folio, plates.

Flora of Herefordshire. Mosses by Aug. Ley. Fungi by M. C. Cooke. 1 vol., 8°, cloth. 1889.

Hooker, W. J., and Baker, J. G. Synopsis Filicum. Colored plates, 8°, cloth. 1868.

DeBary, A. Morphologie und Biologie der Pilze. Mycetozoen und Bacterien. 8°, uncut. 1884.

Natural History Review. Vols. I. to VI., 1854 to 1859 and 1861 to 1865, 11 vols. (wanting Vol. VII.).

American Naturalist, 1867 to 1886 (wanting 1876), in 17 vols., half calf, 2 vols in parts. Also 1887–8 complete; 1889 (wanting 266, 270, 274, 275); 1890 complete; 1891 (wanting 298, 300).

American Entomologist, and American Botanist and Entomologist. 1868–1870. 2 vols. in one, half calf.

Ray (John). Historia Plantarum. 3 vols., folio.

Mitten, W. Musci Indiae Orientalis. 8°, with Griffith's Muscologia Itineris Assamica and Griffith's Notulae ad plantas Asiaticas, part 2. Cryptogamia in 1 vol., 8°, half calf.

Buxbaum J. C. Plantarum minus cognitarum. Complete in 2 vols, 4°.

Girod Chautraus. Recherches chimiques et micro. sur les Conferves. Fol. 36 pl. half calf. 1802.

Gerarde's Herbal. Old folio, wanting title and last page of index, otherwise good condition.

Botanical Tracts, chiefly Cryptogamia, many vols. requiring separate list.

Greville's Scottish Cryptogamic Flora. 6 vols., half morocco, gilt. Colored plates.

Many other works, specially on Fungi, not enumerated here.

In applying for details of price, etc., quote the headings here written.

LONDON, July, 1895.

Contributions from the Herbarium of Columbia College.

[The numbers omitted from this list are out of print.]

VOLUME I.

No. 4. A List of Plants Collected by Miss Mary B. Croft at San Diego, Texas. By N. L. Britton and H. H. Rusby (1887), ... 25 cents.

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